Phase I Project Summary

Firm: Intelligent Automation, Inc.
Contract Number: NNX11CG27P
Project Title: Reconfigurable Power-Aware EVA Radio

Identification and Significance of Innovation: (Limit 200 words or 2,000 characters whichever is less)
Advanced Extra Vehicular Activity (EVA) radio system is a pivotal technology for the successful support of the International Space Station beyond 2020 and future human space exploration missions. It facilitates surface operations, enables crew mobility, and supports point to multi-point communications across rovers, Lander, habitat, and other astronauts. Driven by Communications, Command, Control, and Information interoperability, tight power budgets, and extreme miniaturization, this mobile radio platform must be power efficient and highly adaptive.

Technical Objectives and Work Plan: (Limit 200 words or 2,000 characters whichever is less)
Achieve extreme miniaturization and reconfigurability using state-of-the-art RF micro-electromechanical systems (MEMS) and software defined radio (SDR) technologies; and low power design using hardware, middleware and system level power saving techniques.
• Kickoff meeting and requirements Analysis and Design
• Design and develop the Software Defined Radio
• Conduct system-level simulations and limited measurements to assess impact of vibration on high-Q MEMS tunable filters
• Design and develop middleware that use Adaptive Modulation and Coding techniques
• Evaluate and estimate the proposed radio performance and characteristics

Technical Accomplishments: (Limit 200 words or 2,000 characters whichever is less)

1. We studied the characteristics of MEMS tunable filter under vibrations, and determined that the MEMS filters can withstand significant vibrations.
2. We designed a communication system to support high data rate video and low-data rate telemetry systems: (a) A communication system based on OFDM, occupying 7 MHz resulting in data rates ranging from 2.66 Mbps to 24 Mbps, and (b) a low data rate contingency mode transmission based on spread-spectrum communications.
3. We studied the performance of adaptive modulation, coding and power control under different mission conditions, by optimizing the total power consumption. It was determined that significant power savings can be obtained through adaptive control.
4. A comparison between FPGA-based implementation of communication system, and multi-core-based implementation of a communication system revealed that FPGA was determined to be the most viable SDR platform.
5. We selected Spartan-6 as our choice of FPGA since this represents the lowest power FPGA available in the market with very low static power consumption.
6. We estimate that the eventual size of the EVA radio will be less than 8.22 cubic inches and will weigh less than 1 lb. Power estimates indicate a total transmission power of around 1.36 W, and a receiver power of around 1 W.

NASA Application(s): (Limit 100 words or 1,000 characters whichever is less)
The technology developed in this SBIR effort can benefit many NASA applications, including communication between rovers and spacecraft, astronaut EVA communication networks, space port communications, and asset tracking.

Non-NASA Commercial Application(s): (Limit 200 words or 2,000 characters whichever is less)
The adaptive radios developed are also suitable for commercial and military telecommunication. The proposed reconfigurable software defined radio with tunable filter can prolong the lifespan of the wireless products, reduce the development cost, and reduce electronic waste. The power aware feature of the proposed radio can extend the battery life of many wireless connected devices.

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